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Sampling Methods in Research Methodology; How to Choose a Sampling Technique for Research

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Abstract

In order to answer the research questions, it is doubtful that researcher should be able to collect data from all cases. Thus, there is a need to select a sample. This paper presents the steps to go through to conduct sampling. Furthermore, as there are different types of sampling techniques/methods, researcher needs to understand the differences to select the proper sampling method for the research. In the regards, this paper also presents the different types of sampling techniques and methods.

Key Words

Sampling Method, Sampling Technique, Research Methodology, Probability Sampling, and Non-Probability Sampling.

I. Sampling Methods

In order to answer the research questions, it is doubtful that researcher should be able to collect data from all cases. Thus, there is a need to select a sample. The entire set of cases from which researcher sample is drawn in called the population. Since, researchers neither have time nor the resources to analysis the entire population so they apply sampling technique to reduce the number of cases. Figure 1 illustrates the stages that are likely to go through when conducting sampling.

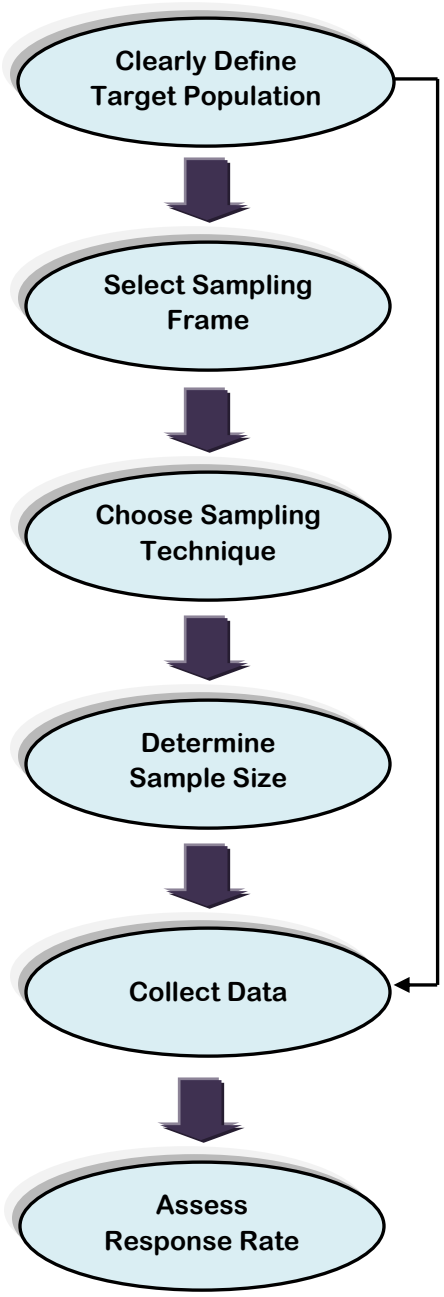

FIGURE 1: SAMPLING PROCESS STEPS

A. Stage 1: Clearly Define Target Population

The first stage in the sampling process is to clearly define target population. Population is commonly related to the number of people living in a particular country.

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B. Stage2: Select Sampling Frame

A sampling frame is a list of the actual cases from which sample will be drawn. The sampling frame must be representative of the population.

C. Stage 3: Choose Sampling Technique

Prior to examining the various types of sampling method, it is worth noting what is meant by sampling, along with reasons why researchers are likely to select a sample. Taking a subset from chosen sampling frame or entire population is called sampling. Sampling can be used to make inference about a population or to make generalization in relation to existing theory. In essence, this depends on choice of sampling technique.

In general, sampling techniques can be divided into two types:

- Probability or random sampling
- Non- probability or non- random sampling

Before choosing specific type of sampling technique, it is needed to decide broad sampling technique. Figure 2 shows the various types of sampling techniques.

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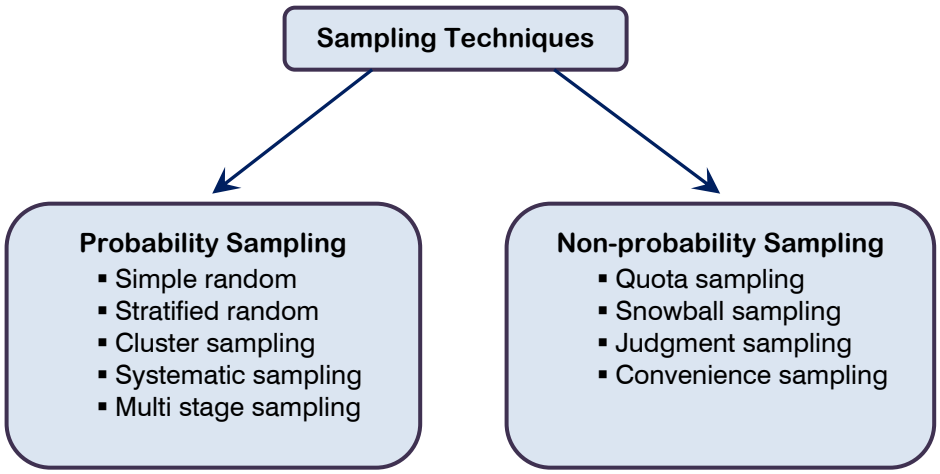

FIGURE I2: SAMPLING TECHNIQUES

1. Probability Sampling

Probability sampling means that every item in the population has an equal chance of being included in sample. One way to undertake random sampling would be if researcher was to construct a sampling frame first and then used a random number generation computer program to pick a sample from the sampling frame (Zikmund, 2002). Probability or random sampling has the greatest freedom from bias but may represent the most costly sample in terms of time and

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energy for a given level of sampling error (Brown, 1947).

1.1. Simple random sampling

The simple random sample means that every case of the population has an equal probability of inclusion in sample. Disadvantages associated with simple random sampling include (Ghauri and Gronhaug, 2005):

- ✓ A complete frame (a list of all units in the whole population) is needed;
- ✓ In some studies, such as surveys by personal interviews, the costs of obtaining the sample can be high if the units are geographically widely scattered;
- ✓ The standard errors of estimators can be high.

1.2. Systematic sampling

Systematic sampling is where every nth case after a random start is selected. For example, if surveying a sample of consumers, every fifth consumer may be selected from your sample. The advantage of this sampling technique is its simplicity.

1.3. Stratified random sampling

Stratified sampling is where the population is divided into strata (or subgroups) and a random sample is taken from each subgroup. A subgroup is a natural set of items. Subgroups might be based on company size, gender or occupation (to name but a few). Stratified sampling is often used where there is a great deal of variation within a population. Its purpose is to ensure that every stratum is adequately represented (Ackoff, 1953).

1.4. Cluster sampling

Cluster sampling is where the whole population is divided into clusters or groups. Subsequently, a random sample is taken from these clusters, all of which are used in the final sample (Wilson, 2010). Cluster sampling is advantageous for those researchers whose subjects are fragmented over large geographical areas as it saves time and money (Davis, 2005). The stages to cluster sampling can be summarized as follows:

- ✓ Choose cluster grouping for sampling frame, such as type of company or geographical region
- ✓ Number each of the clusters
- ✓ Select sample using random sampling

1.5. Multi-stage sampling

Multi-stage sampling is a process of moving from a broad to a narrow sample, using a step by step process (Ackoff, 1953). If, for example, a Malaysian publisher of an

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automobile magazine were to conduct a survey, it could simply take a random sample of automobile owners within the entire Malaysian population. Obviously, this is both expensive and time consuming. A cheaper alternative would be to use multi-stage sampling. In essence, this would involve dividing Malaysia into a number of geographical regions. Subsequently, some of these regions are chosen at random, and then subdivisions are made, perhaps based on local authority areas. Next, some of these are again chosen at random and then divided into smaller areas, such as towns or cities. The main purpose of multi-stage sampling is to select samples which are concentrated in a few geographical regions. Once again, this saves time and money.

2. Non probability Sampling

Non probability sampling is often associated with case study research design and qualitative research. With regards to the latter, case studies tend to focus on small samples and are intended to examine a real life phenomenon, not to make statistical inferences in relation to the wider population (Yin, 2003). A sample of participants or cases does not need to be representative, or random, but a clear rationale is needed for the inclusion of some cases or individuals rather than others.

2.1. Quota sampling

Quota sampling is a non random sampling technique in which participants are chosen on the basis of predetermined characteristics so that the total sample will have the same distribution of characteristics as the wider population (Davis, 2005).

2.2. Snowball sampling

Snowball sampling is a non random sampling method that uses a few cases to help encourage other cases to take part in the study, thereby increasing sample size. This approach is most applicable in small populations that are difficult to access due to their closed nature, e.g. secret societies and inaccessible professions (Breweton and Millward, 2001).

2.3. Convenience sampling

Convenience sampling is selecting participants because they are often readily and easily available. Typically, convenience sampling tends to be a favored sampling technique among students as it is inexpensive and an easy option compared to other sampling techniques (Ackoff, 1953). Convenience sampling often helps to overcome many of the limitations associated with research. For example, using friends or family as part of sample is easier than targeting unknown individuals.

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2.4. Purposive or judgmental sampling

Purposive or judgmental sampling is a strategy in which particular settings persons or events are selected deliberately in order to provide important information that cannot be obtained from other choices (Maxwell, 1996). It is where the researcher includes cases or participants in the sample because they believe that they warrant inclusion.

Table 1 illustrates strengths and weaknesses associated with each respective sampling technique.

TABLE 1: STRENGTHS AND WEAKNESSES OF SAMPLING TECHNIQUES

SOURCE: (MALHOTRA AND BIRKS, 2006)

Technique	Strengths	Weaknesses
Convenience sampling	Least expensive, least time-consuming, most convenient	Selection bias, sample not representative, not recommended by descriptive or casual research
Judgment sampling	Low-cost, convenient, not time-consuming, ideal for exploratory research design	Does not allow generalization, subjective
Quota sampling	Sample can be controlled for certain characteristics	Selection bias, no assurance
Snowball sampling	Can estimate rare characteristics	Time-consuming
Simple random sampling	Easily understood, results projectable	Difficult to construct sampling frame, expensive, lower precision, no assurance of representativeness
Systematic sampling	Can increase representativeness, easier to implement than simple random sampling, sampling frame not always necessary	Can decrease representativeness
Stratified sampling	Includes all important sub-population, precision	Difficult to select relevant stratification variables, not feasible to stratify on many variables, expensive
Cluster sampling	Easy to implement, cost-effective	Imprecise, difficult to compute an interpret results

D. Stage 4: Determine Sample Size

In order to generalize from a random sample and avoid sampling errors or biases, a random sample needs to be of adequate size. What is adequate depends on several issues which often

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confuse people doing surveys for the first time. This is because what is important here is not the proportion of the research population that gets sampled, but the absolute size of the sample selected relative to the complexity of the population, the aims of the researcher and the kinds of statistical manipulation that will be used in data analysis. While the larger the sample the lesser the likelihood that findings will be biased does hold, diminishing returns can quickly set in when samples get over a specific size which need to be balanced against the researcher's resources (Gill et al., 2010). To put it bluntly, larger sample sizes reduce sampling error but at a decreasing rate. Several statistical formulas are available for determining sample size.

There are numerous approaches, incorporating a number of different formulas, for calculating the sample size for categorical data.

$n= p\ (100-p)z^2/E^2$
n is the required sample size
P is the percentage occurrence of a state or condition
E is the percentage maximum error required
Z is the value corresponding to level of confidence required

There are two key factors to this formula (Bartlett et al., 2001). First, there are considerations relating to the estimation of the levels of precision and risk that the researcher is willing to accept:

E is the margin of error(the level of precision) or the risk the researcher is willing to accept (for example, the plus or minus figure reported in newspaper poll results). In the social research a 5% margin of error is acceptable. So, for example, if in a survey on job satisfaction 40% of respondents indicated they were dissatisfied would lie between 35% and 45%. The smaller the value of E the greater the sample size required as technically speaking sample error is inversely proportional to the square root of n, however, a large sample cannot guarantee precision (Bryman and Bell, 2003).

Z concern the level of confidence that the results revealed by the survey findings are accurate. What this means is the degree to which we can be sure the characteristics of the population have been accurately estimated by the sample survey. Z is the statistical value corresponding to level of confidence required. The key idea behind this is that if a population were to be sampled repeatedly the average value of a variable or question obtained would be equal to the true population value. In management research the typical levels of confidence used are 95 percent (0.05: a Z value equal to 1.96) or 99 percent (0.01: Z=2.57). A 95 percent level of confidence implies that 95 out of 100 samples will have the true population value within the margin of error (E) specified.

The second key component of a sample size formula concerns the estimation of the variance or heterogeneity of the population (P). Management researchers are commonly concerned with determining sample size for issues involving the estimation of population percentages or proportions (Zikmund, 2002). In the formula the variance of a proportion or the percentage

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occurrence of how a particular question, for example, will be answered is P(100-P). Where, P= the percentage of a sample having a characteristic , for example, the 40 % of the respondents who were dissatisfied with pay, and (100-P) is the percentage (60%) who lack the characteristic or belief. The key issue is how to estimate the value of P before conducting the survey? Bartlett et al. (2001) suggest that researchers should use 50% as an estimate of P, as this will result in the maximization of variance and produce the maximum sample size (Bartlett et al., 2001).

The formula for determining sample size, of the population has virtually no effect on how well the sample is likely to describe the population and as Fowler (2002) argues, it is most unusual for it (the population fraction) to be an important consideration when deciding on sample size (Fowler, 2002).

Table 2 presents sample size that would be necessary for given combinations of precision, confidence levels, and a population percentage or variability of 50% (the figure which many researchers suggest to maximize variance).

TABLE I: SAMPLE SIZE BASED ON DESIRED ACCURACY

SOURCE: (GILL ET AL., 2010)

`	**Variance of the population P=50%**					
	Confidence level=95% Margin of error			*Confidence level=99% Margin of error*		
Population Size	5	3	1	5	3	1
50	44	48	50	46	49	50
75	63	70	74	67	72	75
100	79	91	99	87	95	99
150	108	132	148	122	139	149
200	132	168	196	154	180	198
250	151	203	244	181	220	246
300	168	234	291	206	258	295
400	196	291	384	249	328	391
500	217	340	475	285	393	485
600	234	384	565	314	452	579
700	248	423	652	340	507	672
800	260	457	738	362	557	763
1000	278	516	906	398	647	943
1500	306	624	1297	459	825	1375
2000	322	696	1655	497	957	1784
3000	341	787	2286	541	1138	2539
5000	357	879	3288	583	1342	3838
10000	370	964	4899	620	1550	6228
25000	378	1023	6939	643	1709	9944
50000	381	1045	8057	652	1770	12413
100000	383	1056	8762	656	1802	14172
250000	384	1063	9249	659	1821	15489
500000	384	1065	9423	660	1828	15984
1000000	384	1066	9513	660	1831	16244

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The sample sizes reflect the number of obtained responses, and not necessarily the number of questionnaires distributed (this number is often increased to compensate for non-response). However, in most social and management surveys, the response rates for postal and e-mailed surveys are very rarely 100%. Probably the most common and time effective way to ensure minimum samples are met is to increase the sample size by up to 50% in the first distribution of the survey (Bartlett et al., 2001).

E. Stage 5: Collect Data

Once target population, sampling frame, sampling technique and sample size have been established, the next step is to collect data.

F. Stage 6: Assess Response Rate

Response rate is the number of cases agreeing to take part in the study. These cases are taken from original sample. In reality, most researchers never achieve a 100 percent response rate. Reasons for this might include refusal to respond, ineligibility to respond, inability to respond, or the respondent has been located but researchers are unable to make contact. In sum, response rate is important because each non response is liable to bias the final sample. Clearly defining sample, employing the right sampling technique and generating a large sample, in some respects can help to reduce the likelihood of sample bias.

II. Conclusion

In this paper, the different types of sampling methods/techniques were described. Also the six steps which should be taken to conduct sampling were explained. As mentioned, there are two types of sampling methods namely; probability sampling and non-probability sampling. Each of these methods includes different types of techniques of sampling. Non-probability Sampling includes Quota sampling, Snowball sampling, Judgment sampling, and Convenience sampling, furthermore, Probability Sampling includes Simple random, Stratified random, Cluster sampling, Systematic sampling and Multi stage sampling.

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Authors' Biography

Hamed Taherdoost is holder of Bachelor degree in the field of Science of Power Electricity, Master of Computer Science (Information Security), Doctoral of Business Administration; Management Information Systems and second PhD in the field of Computer Science.

With over 16 years of experience in the field of IT and Management, Dr Hamed has established himself as an industry leader in the field of Management and IT. Currently he is Chief Executive Officer of Hamta Business Solutions Sdn Bhd, Director and Chief Technological Officer of an IT Company, Asanware Sdn Bhd, Chief Executive Officer of Ahoora Ltd | Management Consultation Group, and Chief Executive Officer of Simurgh Pvt, an International Trade Company.

Remarkably, a part of his experience in industry background, he also has numerous experiences in academic environment. Dr.Hamed has published more than 100 scientific articles in authentic journals and conferences. Currently, he is a member of European Alliance for Innovation, Informatics Society, Society of Computer Science, American Educational Research Association, British Science Association, Sales Management Association, Institute of Electrical and Electronics Engineers (IEEE), IEEE Young Professionals, IEEE Council on Electronic Design Automation, and Association for Computing Machinery (ACM).

Particularly, he is a Certified Ethical Hacker (CEH), Associate in Project Management (CAPM), Information Systems Auditor (CISA), Information Security Manager (CISM), PMI Risk Management Professional, Project Management Professional (PMP), Computer Hacking Forensic Investigator (CHFI) and Certified Information Systems (CIS).

His research interest areas are Management of Information System, Technology Acceptance Models and Frameworks, Information Security, Information Technology Management, Cryptography, Smart Card Technology, Computer Ethics, Web Service Quality, Web Service Security, Performance Evaluation, Internet Marketing, Project Management and Leadership.

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